

A142 613

NATIONAL DAM INSPECTION PROGRAM BRISTOL RESERVOIR DAM
(CT 00008) CONNECTICUT (U) CORPS OF ENGINEERS WALTHAM MA
NEW ENGLAND DIV SEP 78

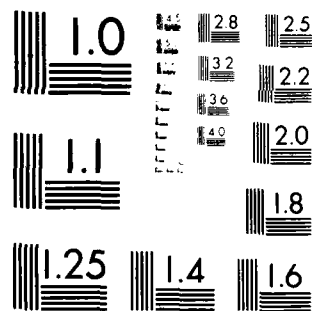
1/1

CLASSIFIED

F/G 13/13

NL

END
DATE
FILMED
8-84
DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CT 00008	2. GOVT ACCESSION NO. AD-A142 613	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Bristol Reservoir Dam; Connecticut River Basin, Bristol Connecticut NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS DEPT. OF THE ARMY, CORPS OF ENGINEERS NEW ENGLAND DIVISION, NEDED 424 TRAPELO ROAD, WALTHAM, MA. 02254		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE September 1978
		13. NUMBER OF PAGES 139
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) APPROVAL FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) DTIC S JUL 2 1984 CF A		
18. SUPPLEMENTARY NOTES Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Connecticut River Basin Bristol, Connecticut		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Bristol Reservoir Dam is an earthfill embankment with a stone masonry core that is 250 ft. long and 25 ft. high. It has a 200 ft. long, 12 ft. wide stone masonry spillway channel and a 10 inch cast iron diversion conduit. The dam is classified as small in size and has a high hazard potential based on downstream habitation. Based on the visual inspection data and past operational performance, the dam is judged to be in fair condition. There are areas which should be stud- ied in order to monitor the dam's behavior such as the excessive seepage at the base of the spillway channel and the seepage through the body of the dam.		

DD FORM 1473

EDITION OF 1 NOV 65 IS OBSOLETE

84 06 29 000

AD-A142 613

DTIC FILE COPY

CONNECTICUT RIVER BASIN
BRISTOL, CONNECTICUT

BRISTOL RESERVOIR DAM
CT. 00008

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

RECEIVED
JUL 2 1984
A

This document has been approved
for public release and sale; its
distribution is unlimited.



DEPA
NEW ENGLAND
W

PERMANENT PROJECT RECORDS
DO NOT DESTROY

84 06 2



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

MAY 23 1979

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:


I am forwarding to you a copy of the Bristol Reservoir Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, the City of Bristol, Bristol Water Department, Bristol, Connecticut 06450.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely yours,


JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

Accession For	
Serial	
Index	
Classification	
Retention	
Disposition	
Other Codes	
Notes	

A-1

NATIONAL INSPECTION PROGRAM

PHASE 1 INSPECTION REPORT

Identification Number:	CT 00008
Name:	Bristol Reservoir Dam
Town:	Bristol
County and State:	Hartford County, Connecticut
Stream:	Pequabuck River
Date of Inspection:	September 21, 1978

BRIEF ASSESSMENT


The Bristol Reservoir Dam is an earthfill embankment with a stone masonry core that is 250 feet long and 25 feet high. It has a 200 foot long, 12 foot wide stone masonry spillway channel and a 10 inch cast iron diversion conduit. The dam is classified as small in size and has a high hazard potential based on downstream habitation.


Based on the visual inspection data and past operational performance, the dam is judged to be in fair condition.

There are areas which should be studied in order to monitor the dam's behavior such as the excessive seepage at the base of the spillway channel and the seepage through the body of the dam.

The drainage area contributing to the dam is 0.359 square miles. The routed test flood outflow (one-half Probable Maximum Flood) is 404 cfs and would overtop the dam by 1.15 feet. The project will pass only 50 percent of the routed test flood peak outflow before overtopping the dam.

Recommended measures to be undertaken by the owner should include monitoring seepage, establishing an inspection program and increasing the spillway capacity. The owner shall implement the recommendations and remedial measures described in Section 7 within two years after receipt of this Phase I Inspection Report.


Joseph F. Merluzzo
Connecticut P.E. #7639
Project Manager


Richard F. Lyon
Connecticut P.E. #8443
Project Engineer

Phase I Inspection Report on Bristol Reservoir Dam
has been reviewed by the undersigned Review Board members. In our
opinion, the reported findings, conclusions, and recommendations are
consistent with the Recommended Guidelines for Safety Inspection
of Dams, and with good engineering judgment and practice, and is
hereby submitted for approval.



CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

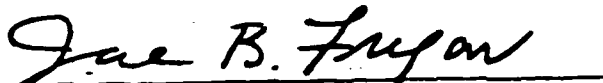


FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division



SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:



JOE B. FRYAR
Chief, Engineering Division

This report is prepared under guidance contained in the Recommended Guidelines for the Inspection of Dams, for Phase I Investigations. Some of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface evaluations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify the need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

TABLE OF CONTENTS

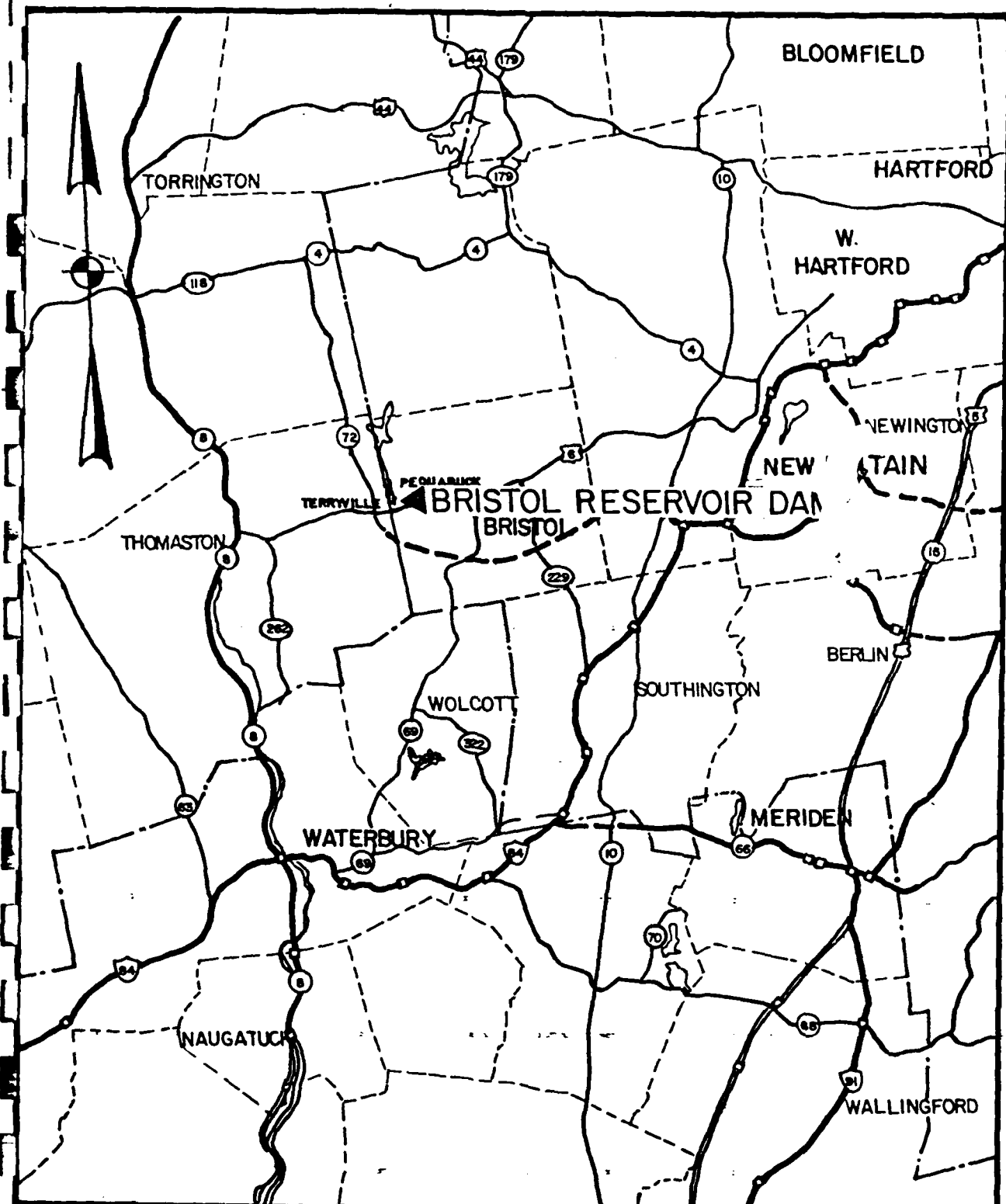
	<u>Page</u>
LETTER OF TRANSMITTAL	
BRIEF ASSESSMENT	i-ii
REVIEW BOARD PAGE	iii
PREFACE	iv
TABLE OF CONTENTS	v-vi
OVERVIEW PHOTO	
LOCATION MAP	vii
REPORT	
SECTION 1 - PROJECT INFORMATION	
1.1 General	1
1.2 Description of Project	2
1.3 Pertinent Data	3
SECTION 2 - ENGINEERING DATA	
2.1 Design	7
2.2 Construction	7
2.3 Operation	7
2.4 Evaluation	7
SECTION 3 - VISUAL INSPECTION	
3.1 Findings	8
3.2 Evaluation	10
SECTION 4 - OPERATIONAL PROCEDURES	
4.1 Procedures	11
4.2 Maintenance of Dam	11
4.3 Maintenance of Operating Facilities	11
4.4 Description of Warning System	11
4.5 Evaluation	11

TABLE OF CONTENTS (CONTINUED)

	<u>Page</u>
SECTION 5 - HYDRAULIC/HYDROLOGIC	
5.1 Evaluation of Features	12
SECTION 6 - STRUCTURAL STABILITY	
6.1 Evaluation of Structural Stability	14
SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES	
7.1 Dam Assessment	16
7.2 Recommendations	17
7.3 Remedial Measures	17
<u>APPENDIX MATERIALS</u>	
A VISUAL INSPECTION CHECK LIST	A-1 to A-4
B LIST OF REFERENCES	B-1
GENERAL PLAN	Plate 1
SECTION AND DETAILS	Plate 2
C PHOTO LOCATION PLAN	Plate 3
PHOTOGRAPHS	C-1 to C-4
D HYDRAULIC COMPUTATIONS	D-1 to D-5
REGIONAL VICINITY MAP	Plate 4
DRAINAGE AREA MAP	Plate 5
E INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS	



OVERVIEW PHOTO



U.S. ARMY, CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASS.

0 10
APPROXIMATE SCALE
SCALE OF MILES

LOCATION MAP

PHASE I INSPECTION REPORT
BRISTOL RESERVOIR DAM CT 00008

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Storch Engineers has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Storch Engineers under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0000 has been assigned by the Corps of Engineers for this work.

b. Purpose -

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

PHASE I INSPECTION REPORT
BRISTOL RESERVOIR DAM CT 00008

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Storch Engineers has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed was issued to Storch Engineers under a letter of May 3, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW33-78-C-0000 has been assigned by the Corps of Engineers for this work.

b. Purpose -

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.

(2) Encourage and assist the States to initiate quickly, effective dam safety programs for non-Federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Description of Project

a. Location - The Bristol Reservoir Dam is located just off U.S. Route 6 approximately 10 miles west of Hartford in the City of Bristol, Connecticut (See Location Map).

b. Description of the Dam and Appurtenances - The structure is an earth embankment with a stone masonry core. The dam is 250 feet long and 25 feet high (Appendix B, Plates 1 and 2). It has a combined emergency spillway and channel as well as a diversion conduit with a gate valve.

c. Size Classification - The size classification of the dam is small. Both the height and storage (25 feet high and 348 acre-feet of storage) governs the classification per the criteria set forth in the Recommended Guidelines for Safety Inspection of Dams (small - greater than 25 and less than 40 feet high and greater than 50 and less than 1,000 acre-feet of storage) by the Corps of Engineers.

d. Hazard Classification - The hazard classification is high per criteria set forth in the guidelines mentioned in Section 1.2.c above. Failure of this dam would affect approximately 20 houses as well as portions of Bristol's downtown business district (Appendix D, Plate 4).

e. Ownership - The Bristol Reservoir Dam is owned by the Bristol Water Department, City of Bristol, Connecticut.

f. Operator - The person in charge of day to day operation of the dam is John Burns, Bristol Water Department, Bristol, Connecticut 06010; Telephone Number: 582-7431.

g. Purpose of Dam - The dam impounds the Bristol Reservoir No. 1 and serves as a drinking water supply for the City of Bristol.

h. Design and Construction History - The Bristol Reservoir Dam was built around the year 1885 and was taken over in 1910 by the Bristol Water Department. There is one contract drawing available of the original construction but no other design calculations had been done. Neither the contractor nor the details of construction were known by any of the Bristol Water Department's personnel.

i. Normal Operational Procedures - There is a regular staff of maintenance personnel from the Bristol Water Department available. Regular maintenance includes the cutting of grass on the embankment of the dam.

1.3 Pertinent Data

a. Drainage Area - A 229 acre drainage area contributes to the dam. The terrain is rolling with mixed amounts of open space and residential development.

b. Discharge at Damsite - The maximum known spillway discharge was approximately 200 cfs during the flood of August, 1955.

(1) Outlet works: (conduits) size 10 inch and invert elevation 582.5.

(2) Maximum known flood at damsite: 200 cfs.

(3) Ungated spillway capacity at maximum pool elevation: 200 cfs at 603 elevation.

(4) Gated spillway capacity at pool elevation: N/A cfs at N/A elevation.

(5) Gated spillway capacity at maximum pool elevation: N/A cfs at N/A elevation.

(6) Total spillway capacity at maximum pool elevation: 200 cfs at 603 elevation.

c. Elevation (Feet above MSL)

(1) Top of dam: 603

(2) Maximum pool-design surcharge: 603

(3) Full flood-control pool: N/A

(4) Recreation pool: N/A

(5) Spillway crest: 599

(6) Upstream portal invert diversion tunnel: 582.5

(7) Streambed at centerline of dam: 582

(8) Maximum tailwater: 584

d. Reservoir

- (1) Length of maximum pool: 3,200 feet ±
- (2) Length of recreation pool: N/A
- (3) Length of flood-control pool: N/A

e. Storage (Acre-Feet)

- (1) Recreation pool: N/A
- (2) Flood-control pool: N/A
- (3) Design surcharge: 348 ±
- (4) Top of Dam: 348 ±

f. Reservoir Surface (Acres)

- (1) Top of dam: 55 ±
- (2) Maximum pool: 55 ±
- (3) Flood-control pool: N/A
- (4) Recreation pool: N/A
- (5) Spillway crest: 27.5

g. Dam

- (1) Type: Earth embankment
- (2) Length: 250 feet ±
- (3) Height: 25 feet ±
- (4) Top Width: 22 feet ±
- (5) Side Slopes: 1:1.5
- (6) Zoning: see section (Plate 2)
- (7) Impervious Core: Stone masonry
- (8) Cutoff: unknown
- (9) Grout curtain: unknown
- (10) Other: N/A

h. Diversion and Regulating Tunnel

- (1) Type: Cast iron
- (2) Length: 55 feet ±
- (3) Closure: N/A
- (4) Access: None
- (5) Regulating Facilities: manually operated gate valve, (10" blowoff)

i. Spillway

- (1) Type: Stone masonry channel
- (2) Length of weir: 12 feet
- (3) Crest elevation: 599 feet
- (4) Gates: none
- (5) U/S Channel: underwater
- (6) D/S Channel: overgrown with brush
- (7) General: N/A

j. Regulating Outlets

Regulating outlet is a 10 inch blowoff that discharges just below the dam.

- (1) Invert: 582.5
- (2) Size: 10 inch
- (3) Description: Cast iron
- (4) Control Mechanism: manually operated gate valves
- (5) Other: N/A

SECTION 2 - ENGINEERING DATA

2.1 Design

The facility was built around 1885. There is no design information available. The Bristol Water Department took over the dam in 1910.

2.2 Construction

There are no records or photographs available of the 1885 construction.

2.3 Operation

The water level in this reservoir is controlled by valves that are in valve boxes at the toe of the dam.

2.4 Evaluation

a. Availability - A schematic drawing of the dam prepared by the Bristol Water Department was readily available. Because of the age of the dam, there was no design information. The dam has no emergency procedures in case of overtopping.

b. Adequacy - The information that was made available was only a minor factor in the assessment which was based mainly on the visual inspection, past performance history and hydrologic and hydraulic assumptions.

c. Validity - The schematic drawing provided by the Bristol Water Department was accurate to the extent that the visual inspection did not reveal any new features.

SECTION 3 - VISUAL INSPECTION

3.1 Findings

a. General - The visual inspection was conducted on September 21, 1978 by members of the engineering staff of Storch Engineers. A copy of the visual inspection check list is contained in Appendix A of this report.

Before the inspection, a contract drawing of the dam that was made available by the Bristol Water Department was studied. A compact sketch of the dam was made for orientation during the inspection (Appendix B, Plate 1).

In general, the overall appearance and condition of the dam is fair.

b. Dam - According to the data sheet supplied from the Bristol Water Department, the body of the dam is composed of earth fill with a stone masonry core. The crest of the dam has no visible bulges or cracks (Appendix B, Plates 1 and 2). Several rodent holes were found on the dam face and soft ground was noted on the downstream slope of the dam (Appendix C, Photo 2). Inspection of the toe showed some seepage, which included several marshy areas that are noted in Appendix B on Plate 1. The seepage water was clear and did not appear to be carrying any sediment. There is an extensive seepage source at the downstream zone of the

spillway channel with a discharge of approximately 1 gallon per second (Appendix C, Photo 8). Seepage from the drainage pipe through the masonry headwall and at the toe of the dam totals approximately 6 to 8 gallons per minute (Appendix C, Photo 7).

c. Appurtenant Structures - The appurtenant structures are the spillway, the diversion conduit and the spillway channel. The fieldstone spillway shown in Appendix C, Photos 3 and 4, appears to be in fair condition with a considerable amount of grass growing through the mortar joints.

There is need for some restoration of the spillway because there are some areas of structural distress. This distress is the cracking of walls and some spalling. There are two valves at the toe of the dam. The upper valve is always open.

d. Reservoir Area - Inspection of the area adjacent to the embankment of the dam indicated a very rolling wooded terrain.

e. Downstream Channel - The downstream channel (Appendix C, Photo 6) of the spillway is overgrown with brush and it is very difficult to define its actual location. The channel seems to follow the natural fall and presently has no form of slope protection. It stays moist from the seepage flows out of the body of the dam (Appendix C, Photo 8). There is

a concentrated seepage flow at the end of the spillway channel with a discharge of approximately 1 gallon per second. This flow along with other flows results in a total seepage flow of 2 to 3 gallons per second.

3.2 Evaluation

Overall, the general condition of the dam and appurtenant structures based on the results of the visual inspection is fair. The observation of the extensive zones of seepage on the downstream slope of the dam and the spillway channel indicates a need for further study so that the extent of this problem can be defined.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures

The responsibility for maintenance is with the Bristol Water Department with engineering and construction assistance from the City of Bristol, Public Works Department. There is no formal procedure for lowering the reservoir during seasons of heavy rain. The reservoir is essentially filled and lowered depending on the requirements of the adjacent Water Treatment Plant.

4.2 Maintenance of Dam

There are tasks of routine maintenance performed, however, it primarily consists of cutting the grass on the face of the dam. Items such as clearing the downstream and upstream embankment of trees and brush have not been undertaken for years. The maintenance of the spillway channel and weir has been neglected.

4.3 Maintenance of Operating Facilities

There are no procedures for maintenance of the operating facilities.

4.4 Description of Warning System

There is no warning system in effect.

4.5 Evaluation

In view of the limited routine maintenance procedures, it is suggested that an expanded program be established.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data - The 12 foot spillway and 10 inch blowoff are the only means of transmitting water past the dam. Under conditions of the test flood (1/2 the Probable Maximum Flood), the spillway will carry only a portion of the flood water.

Using the guide curves supplied by the Corps of Engineers (rolling terrain), the test flood peak inflow into the reservoir is 600 cfs and the routed outflow is 404 cfs. The pond elevation at the test flood outflow is 604.15 or 1.15 feet over the top of the dam. The capacity of spillway at the top of the dam is only 200 cfs or approximately 50 percent of the routed test flood outflow (Appendix D).

b. Experience Data - The Bristol Reservoir Dam has experienced the floods of November, 1927; March, 1936; September, 1938 and August (maximum) and October, 1955. During the flood of August, 1955, the elevation of the pond was approximately 603 feet and the discharge was approximately 200 cfs.

c. Visual Observations - The spillway at the time of the inspection was in fair condition with evidence of water seepage at the lower end and grass and brush growing up through joints (Appendix C, Photo 4).

The channel downstream is overgrown with trees and brush and is not conducive to the free passage of flood flows.

The 10 inch blowoff is in good condition but the valves are hardly ever used.

d. Overtopping Potential - Calculations by Storch Engineers indicates that the test flood outflow will overtop the dam by 1.15 feet (Appendix D).

SECTION 6 - STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation - There have been no routine inspections performed by the resident staff. In April, 1975, the dam was inspected by personnel of the State Department of Environmental Protection and a slight seepage was noted through the dam. The present visual inspection showed that the structural stability of the dam is satisfactory, however, the seepage and the wet spots on the downstream slope of the dam will require further examination.

b. Design and Construction Data - The only design and construction data available was one drawing prepared by a private company after the construction of the dam.

c. Operating Records - There are no operating records for the dam. The water level of the Bristol Reservoir is not monitored.

d. Post Construction Changes - The only change that has been noted since the completion of the dam construction in 1885 is the installation of a rock toe at the base of the dam about ten years ago. The installation was done by the Bristol Water Department and no plan or procedure for this work is available. The design consultant is not known.

e. Seismic Stability - The dam is located in Seismic Zone 1 and in accordance with Recommended Phase I Guidelines does not warrant seismic analysis.

SECTION 7 - ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition - After review of the available documents, the results of this inspection, meetings with resident staff and the hydraulic computations, the general condition of the Bristol Reservoir Dam is judged to be fair.

There is some concern over the soft ground on the downstream slope of the dam, the extensive seepage at the end of the spillway channel and the insufficient capacity of the spillway.

b. Adequacy of Information - The information available is such that the assessment of the safety of the dam should be based primarily on the visual inspection results, the past operational performance of the dam and its appurtenant structures.

c. Urgency - The owner shall implement the recommendations suggested below within two years after receipt of this Phase I Inspection Report.

d. Need for Additional Investigation - Additional investigations should be implemented by the owner as outlined in the following sections.

7.2 Recommendations

In view of the lack of engineering data for evaluating the dam's behavior, it is recommended that the following measures be undertaken:

- a. Monitoring of the dam for seepage including any necessary seepage analyses or other pertinent studies.
- b. Determination of the geometry of the dam, elevations of its top and base, properties of the soil of the dam and its foundation rock. This would permit an objective assessment of the structural stability of the dam.
- c. Further detailed studies of the spillway capacity and an increase of the total project discharge capacity if found to be needed.

The above recommendations should be done by a qualified registered professional engineer or engineering firm.

7.3 Remedial Measures

It is considered important that the following items be attended to as early as practical:

- a. Alternatives - Not applicable.
- b. O & M Maintenance and Procedures -
 1. Brush and trees on the downstream slopes, the face of the dam and the spillway channel

should be removed to facilitate the visual observation of existing and potential seepage and movement.

2. Loose materials and brush should be cleaned from the spillway channel.
3. Plans for around-the-clock surveillance should be provided for periods of unusually heavy rains and a formal warning system should be developed for use in the event of an emergency.
4. Seepage from the toe drain should be monitored.
5. A program of biennial periodic technical inspection should be established.

APPENDIX A

VISUAL INSPECTION CHECK LIST A-1 to A-4

VISUAL INSPECTION CHECK LIST
PARTY ORGANIZATION

PROJECT Bristol Reservoir Dam

DATE 9-21-78

TIME 11:00 a.m.

WEATHER Sunny

W.S. ELEV. 599.0± U.S. N/A DN.S.

PARTY:

- | | |
|---------------------------|-----------|
| 1. <u>Richard Lyon</u> | 6. _____ |
| 2. <u>Miron Petrovsky</u> | 7. _____ |
| 3. <u>Gary Giroux</u> | 8. _____ |
| 4. <u>John Schearer</u> | 9. _____ |
| 5. <u>Rodolfo Aloma</u> | 10. _____ |

PROJECT FEATURE	INSPECTED BY	REMARKS
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____

PERIODIC INSPECTION CHECK LIST

PROJECT Bristol Reservoir Dam

DATE 9-21-78

PROJECT FEATURE _____

NAME R. Lyon

DISCIPLINE _____

NAME G. Giroux

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	Good
Current Pool Elevation	Good
Maximum Impoundment to Date	Good
Surface Cracks	Some tunneling by rodents
Pavement Condition	N/A
Movement or Settlement of Crest	None observed
Lateral Movement	None observed
Vertical Alignment	None observed
Horizontal Alignment	None observed
Condition at Abutment and at Concrete Structures	N/A
Indications of Movement of Structural Items on Slopes	None observed
Trespassing on Slopes	Not permitted
Sloughing or Erosion of Slopes or Abutments	None observed, however, there are several rodent holes
Rock Slope Protection - Riprap Failures	None observed
Unusual Movement or Cracking at or near Toes	None observed
Unusual Embankment or Downstream Seepage	Wet swampy area downstream of toe drains
Piping or Boils	None observed
Foundation Drainage Features	Toe drains installed -
Toe Drains	nearly 10 years ago
Instrumentation	A-2 No

PERIODIC INSPECTION CHECK LIST

PROJECT Bristol Reservoir Dam

DATE 9-21-78

PROJECT FEATURE _____

NAME M. Petrovsky

DISCIPLINE _____

NAME R. Aloma

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - TRANSITION AND CONDUIT</u>	
General Condition of Concrete	Conduit set in riprap headwall
Rust or Staining on Concrete	N/A
Spalling	N/A
Erosion or Cavitation	None
Cracking	Not observed
Alignment of Monoliths	Not observed
Alignment of Joints	Not observed
Numbering of Monoliths	N/A

PERIODIC INSPECTION CHECK LIST

PROJECT Bristol Reservoir Dam

DATE 9-21-78

PROJECT FEATURE _____

NAME G. Giroux

DISCIPLINE _____

NAME J. Schearer

AREA EVALUATED	CONDITION
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Approach Channel	Somewhat overgrown with weeds
b. Weir and Training Walls	
General Condition of Concrete	N/A, masonry walls
Rust or Staining	N/A
Spalling	Some holes observed
Any Visible Reinforcing	N/A
Any Seepage or Efflorescence	Minor spot
Drain Holes	None
c. Discharge Channel	
General Condition	Fair
Loose Rock Overhanging Channel	None
Trees Overhanging Channel	None
Floor of Channel	Floor overgrown with trees
Other Obstructions	None

APPENDIX B

LIST OF REFERENCES

B-1

GENERAL PLAN

Plate 1

SECTION AND DETAILS

Plate 2

LIST OF REFERENCES

1. Drawing: Cross section and plan of Bristol Reservoir Dam; Bristol Water Department, 1911.
2. Recommended Guidelines for Safety Inspection Of Dams; Department of the Army; Office of the Chief of Engineers; Washington, D.C.; November, 1976.
3. Guide Curves for the Probable Maximum Flood (PMF) for Regions of New England based on past Corps of Engineers' Studies; March, 1978.
4. Preliminary Guidance for Estimating Maximum Probable Discharges in Phase I Dam Safety Investigations; New England Division; Corps of Engineers; March, 1978.
5. Rule of Thumb. Guidance for Estimating Downstream Dam Failure Hydrographs; Corps of Engineers; April, 1978.
6. Instrumentation of Earth and Rock Fill Dams. EM 1110-2-1908; Department of the Army, Corps of Engineers; August, 1971.

APPENDIX C

PHOTO LOCATION PLAN

Plate 3

PHOTOGRAPHS

C-1 to C-4



PHOTO 1
CREST OF DAM



PHOTO 2
DOWNSTREAM FACE OF DAM



PHOTO 3
SPILLWAY LOOKING DOWNSTREAM



PHOTO 4
SPILLWAY LOOKING UPSTREAM

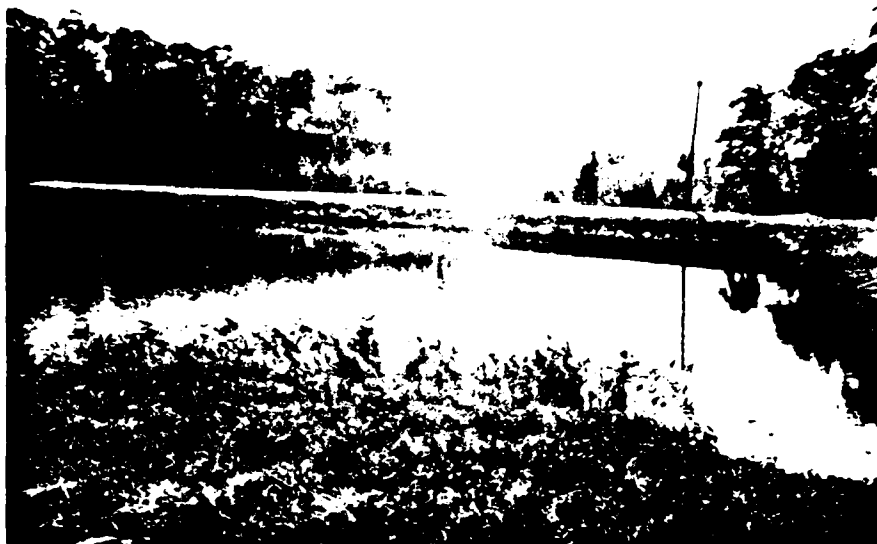


PHOTO 5
UPSTREAM FACE DAM



PHOTO 6
DOWNSTREAM CHANNEL



PHOTO 7
SEEPAGE FROM TOE DRAIN

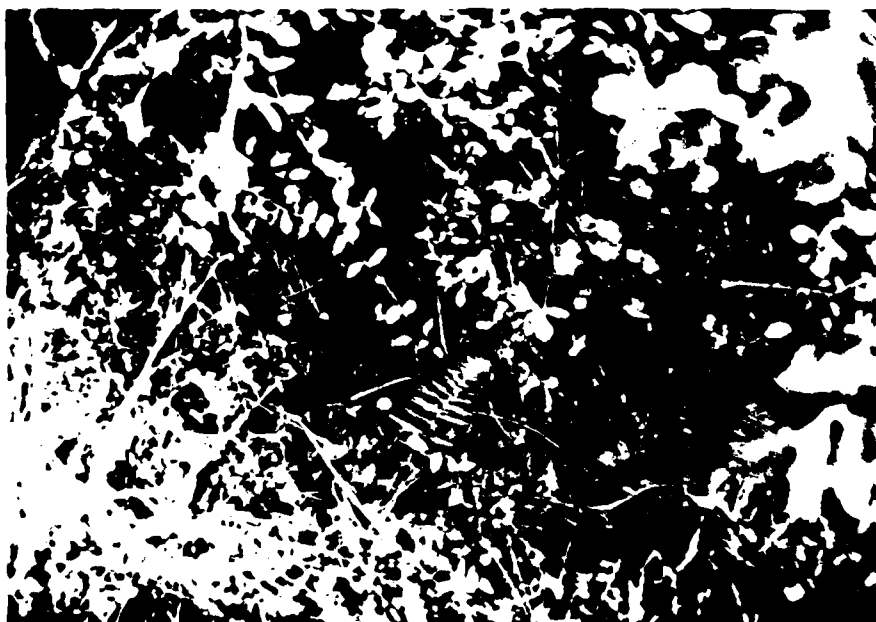


PHOTO 8
SEEPAGE FROM BOTTOM OF SPILLWAY

APPENDIX D

HYDRAULIC COMPUTATIONS

D-1 to D-5

REGIONAL VICINITY MAP

Plate 4

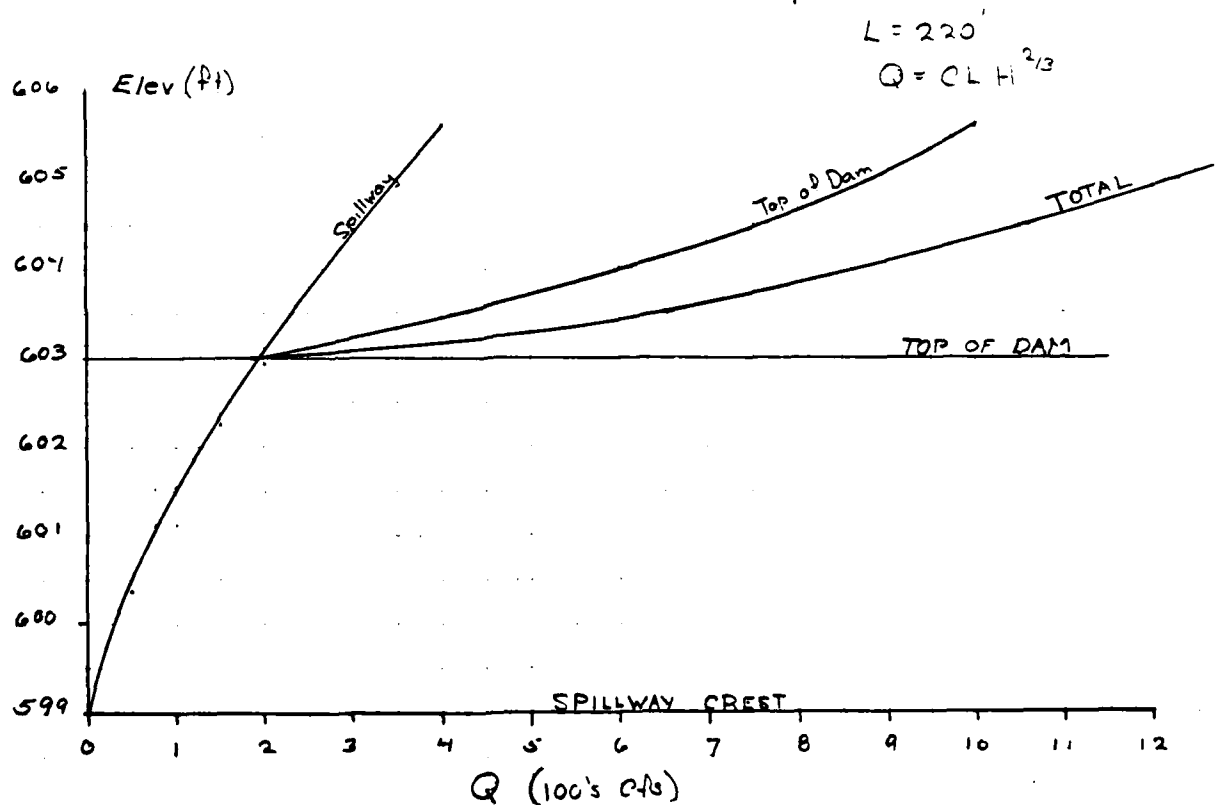
DRAINAGE AREA MAP

Plate 5

STORCH ENGINEERS
Engineers - Landscape Architects
Planners - Environmental Consultants

Bristol Reservoir Dam.
Stage Discharge

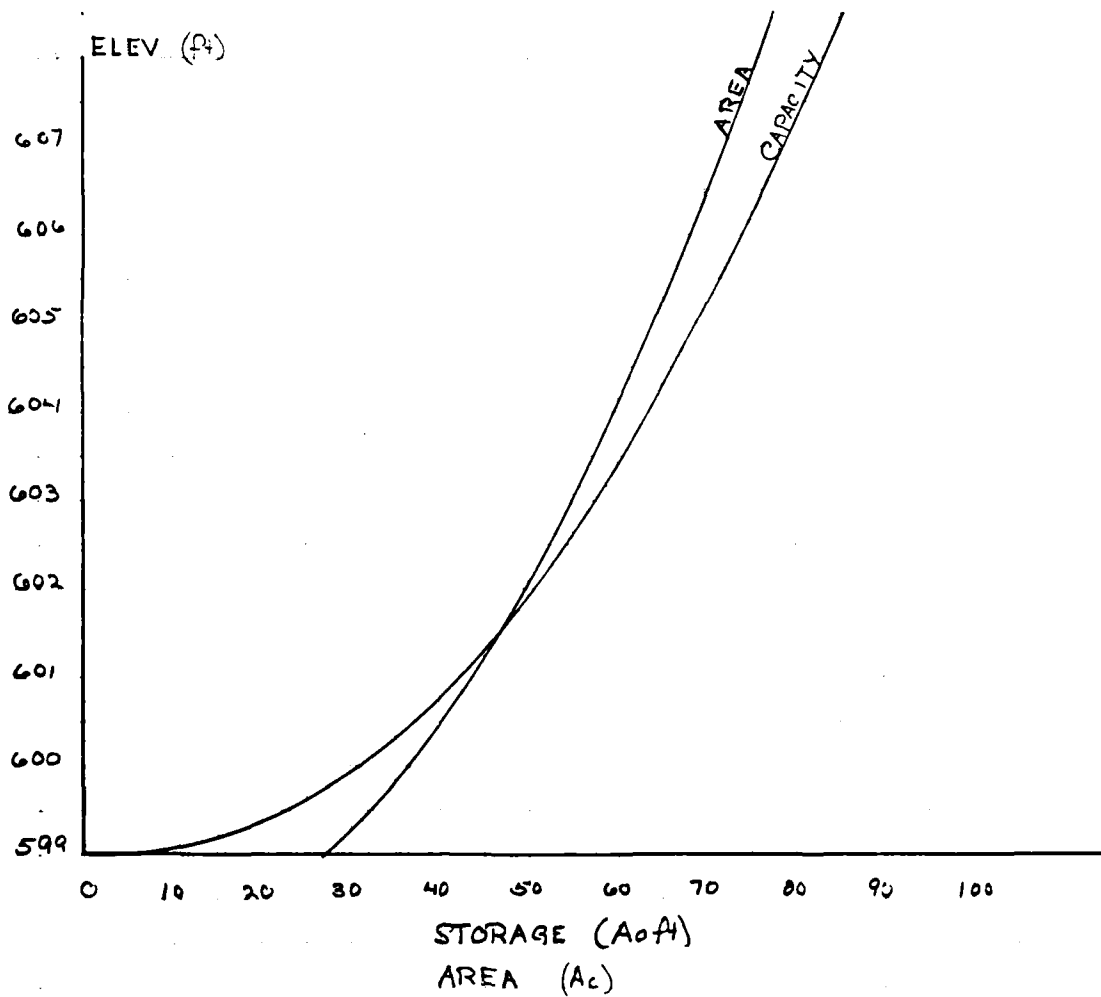
Q	SPILLWAY				Elev	DAM		
	d	V	(1+k)H _v			H	C	Q
50	0.7	6.0	.67		600.37			
75	1.2	7.0	.91		601.11			
100	1.4	7.8	1.13		601.53			
150	1.8	8.9	1.47		602.27			
175	2.05	9.25	1.59		602.64			
200	2.2	9.7	1.75		602.95			
300	3.0	11.5	2.46		604.46	1.46	2.64	747
400	3.7	12.5	2.91		605.61	2.61	2.63	1097
500	4.2	13.0	3.1		606.3	3.3	2.63	1283
600	4.8	13.5	3.39		607.19	4.19	2.63	1500



STORCH ENGINEERS
Engineers - Landscape Architects
Planners - Environmental Consultants

BRISTOL RESERVOIR DAM
AREA-CAPACITY

Elev	Depth	Area	Avg Area	Vol	ΣVol
599		27.5			0
	1		32.1	32.1	
600		36.7			32.1
	10		59.65	596.5	
610		82.6			91.75



STORCH ENGINEERS
Engineers - Landscape Architects
Planners - Environmental Consultants

BRISTOL RESERVOIR DAM
DETERMINATION OF SDF & PMF

Drainage Area .359 SM

Inflow - 3350 cfs/SM

$$\frac{1}{2} \text{PMF} = \frac{1}{2} 3350 (.359) = 600 \text{ cfs}$$

Determine the effect of surcharge on the Maximum Probable Discharge

① $Q_{P1} = 600 \text{ cfs}$

② a. $H_1 = 603.4$ (elev)

b. $\text{STOR} = 3.14$

c. $Q_{P2} = Q_{P1} (1 - \text{STOR}/9.5) = 600 (1 - 3.14/9.5) = 401.0 \text{ cfs}$

③ a. $H_2 = 603.2$

b. $\text{STOR} = 3.06$

$\text{STOR}_A = 3.1$

$$Q_{P3} = 600 (1 - 3.1/9.5) = 404 \text{ cfs}$$

$$H_A = 603.15$$

$$\text{STOR}_A = 3.02 \text{ } \underline{\text{OK}}$$

$$\frac{1}{2} \text{PMF} = 404 \text{ cfs}$$

Capacity of the spillway when the pond is at top of dam

$$Q = 200 \text{ cfs} \text{ or } 50 \% \text{ of PMF}$$

STORCH ENGINEERS
Engineers - Landscape Architects
Planners - Environmental Consultants

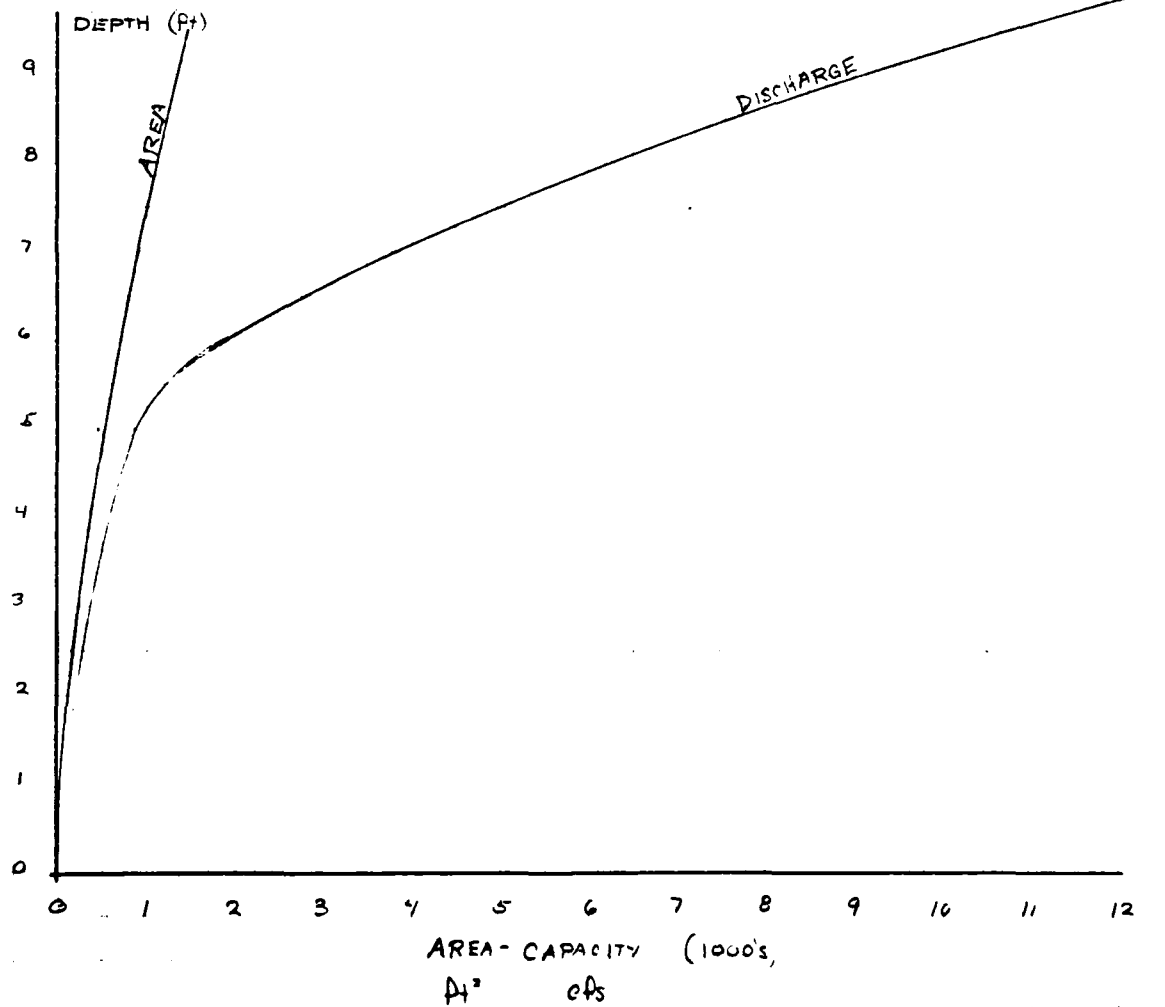
BRISTOL RESERVOIR DAM
TYPICAL SECTION



$n = .05$ $S = .83\%$

SCALE
 $1'' = 200'$
 $1'' = 200'$

D	W	A	R	$R^{2/3}$	$S^{1/2}$	V	Q
5	170	450	2.64	1.91	.091	5.16	878
10	330	1600	4.84	2.87	.091	7.76	12,419
20	590	6000	10.16	4.69	.091	12.68	76,105
7.5	240	1000	4.27	2.63	.091	7.12	7,122



STORCH ENGINEERS
Engineers • Landscape Architects
Planners • Environmental Consultants

**"RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE
HYDROGRAPHS**

SECTION I @ DAM

① $S = 353 \text{ A.c.ft.}$

② $Q_{p1} = \frac{8}{27} (80) \sqrt{32.2} \cdot 21^{3/2} = 12944 \text{ cfs}$

SECTION II @ Terryville Sta

③ see Rating Curve

④ a. $H_1 = 10.2' \quad A_1 = 1650 \text{ ft}^2 \quad L_1 = 4300'$

$V_1 = 162.87 \text{ A.c.ft.}$

b. $Q_{p1} = 12944 (1 - \frac{162.87}{353}) = 6971 \text{ cfs}$

c. $H_2 = 8.25' \quad A_2 = 1200 \text{ ft}^2$

$A_A = 1425 \text{ ft}^2 \quad V_2 = 140.6$

$Q_{p2} = 12944 (1 - \frac{140.6}{353}) = 7788 \text{ cfs}$

$H_2 = 8.6' \quad A_2 = 1425 \text{ ft}^2$

SECTION III @ 4000' D/S from Terryville Sta.

④ a. $H_2 = 8.6' \quad A_2 = 1425 \text{ ft}^2 \quad L_2 = 4000'$

$V_2 = 130 \text{ A.c.ft.}$

b. $Q_{p3} = 7788 (1 - \frac{130}{353}) = 4920 \text{ cfs}$

c. $H_3 = 7.5' \quad A_3 = 1000 \text{ ft}^2$

$A_A = 1212 \text{ ft}^2 \quad V_3 = 111.3 \text{ A.c.ft.}$

$Q_{p3} = 7788 (1 - \frac{111}{353}) = 5829 \text{ cfs}$

$H_3 = 7.6' \quad A_3 = 1050 \text{ ft}^2$

SECTION IV @ Muzzy Field

④ a. $H_3 = 7.6' \quad A_3 = 1050 \quad L = 5000' \quad V_3 = 120'$

b. $Q_{p4} = 5330 (1 - \frac{120}{353}) = 3524 \text{ cfs}$

c. $H_4 = 6.75' \quad A_4 = 850 \text{ ft}^2$

$A_A = 950 \text{ ft}^2 \quad V_4 = 109 \text{ A.c.ft.}$

$Q_{p4} = 5330 (1 - \frac{109}{353}) = 3690 \text{ cfs}$

$H_4 = 6.8'$



LEGEND

— DENOTES DRAINAGE AREA

FROM U.S.G.S. QUAD. SHEET
BRISTOL, CONNECTICUT

U.S. ARMY, CORPS OF ENGINEERS
NEW ENGLAND DIVISION
WALTHAM, MASS.

SCALE
0 1 MILE

DRAINAGE AREA MAP

PLATE 5

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL
INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

DATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	DIST	CONSTR	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY MO YR

CT

POPULAR NAME		NAME OF IMPONDMENT	
		WHISTOL RESERVOIR NO 1	
RECONSTR	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI)
N10A	PEQUANUCK RIVER	PEQUANUCK	1
POPULATION		700	

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT)	HYDRAULIC HEAD (FT)	IMPONDING CAPACITY (ACRES)	DIST OWN	FED R	PRV/FED	SCS A	VER/DATE
GR2PG	1985	S	25	21	30A	200	NED	N	N	15JAN79

REMARKS	
20-ESTIMATE 22-APPROXIMATE	

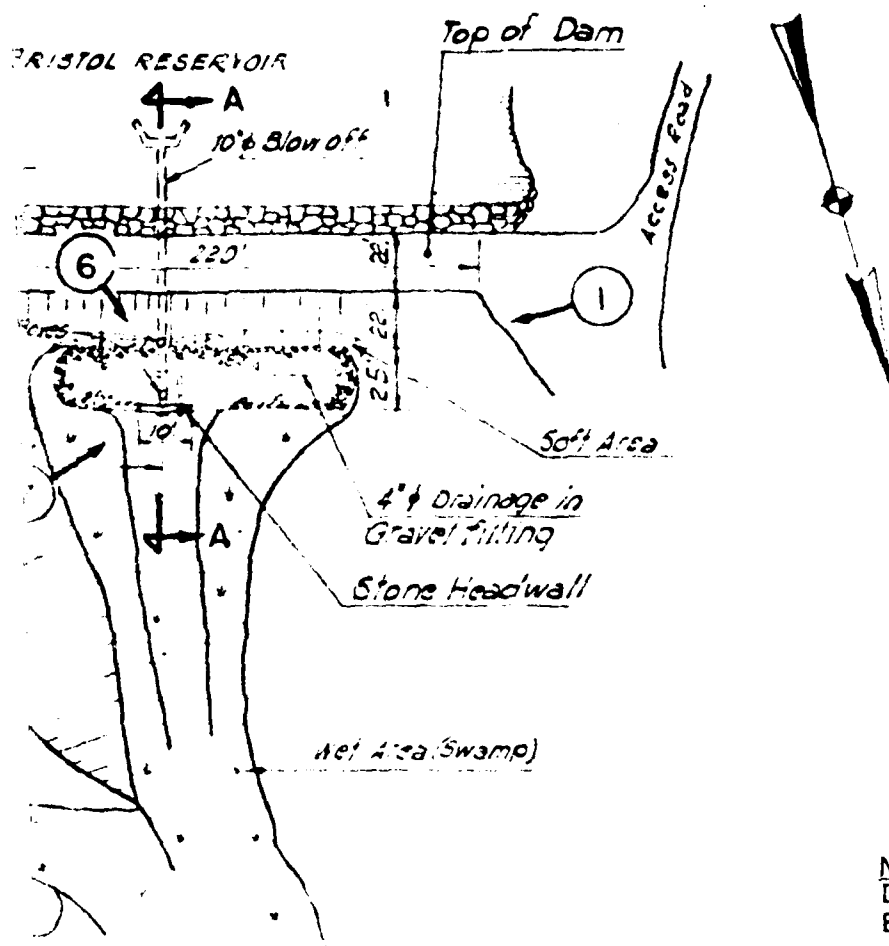
DIS	HAS	SPILLWAY	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CU)	POWER CAPACITY (MW)	INSTALLED PROPOSED	LENGTH (FT)	WIDTH (FT)	HEIGHT (FT)	DEPTH (FT)	BUDGET

OWNER	ENGINEERING BY	CONSTRUCTION BY
CITY OF WHISTOL CT	NOT KNOWN	NOT KNOWN

REGULATORY AGENCY	
DESIGN	CONSTRUCTION
NONE	NONE

INSPECTION BY		INSPECTION DATE		AUTHORITY FOR INSPECTION	
STONCH ENGINEERS		21SEP78		PL92-367	

REMARKS	
20-APPROXIMATE	



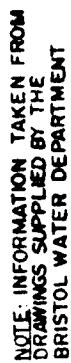
NOTE: INFORMATION TAKEN FROM
DRAWINGS SUPPLIED BY THE
BRISTOL WATER DEPARTMENT

GENERAL PLAN

ENOTES PHOTO LOCATION

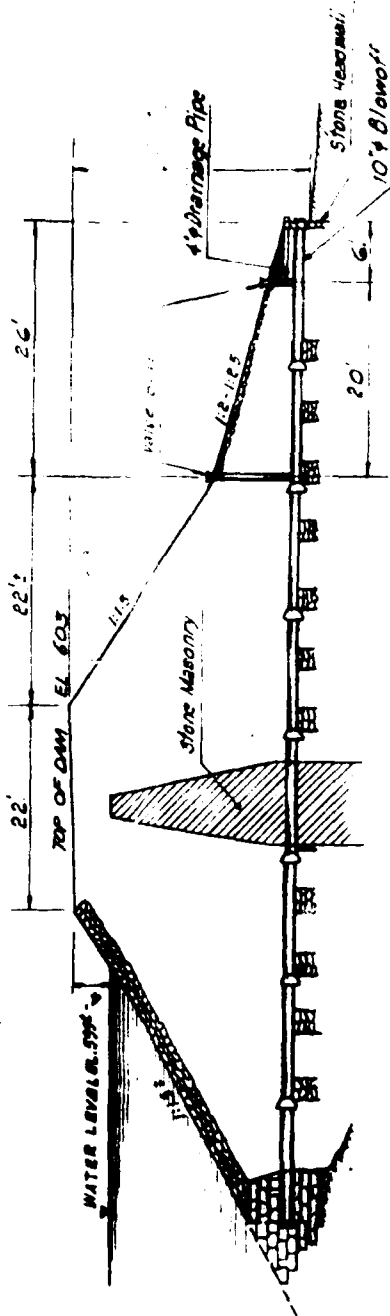
STORCH ENGINEERS WETHERFIELD, CONNECTICUT		U.S. ARMY ENGINEER DIV NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS	
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS BRISTOL RESERVOIR DAM			
PEQUABUCK RIVER		CONNECTICUT	
		SCALE: NOT TO SCALE	
		DATE: Nov. 1978	

(2 of 2)



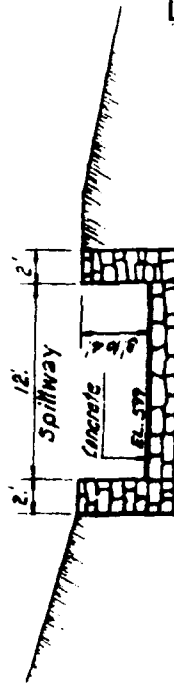
GENERAL PLAN

STORCH ENGINEERS BOSTON, MASSACHUSETTS	U.S. ARMY ENGINEER DISTRICT OFFICE CONTRACT NO. W-33-00-0000 DIST. NO. 10000		PLATE-1
	NATIONAL PROGRAM OF INSPECTION OF NON-FEED DAMS		
BRISTOL RESERVOIR DAM		CONNECTICUT	
PEQUABUCK RIVER	SCALE: NOT TO SCALE		
	DATE: Nov. 1974		



SECTION A-A

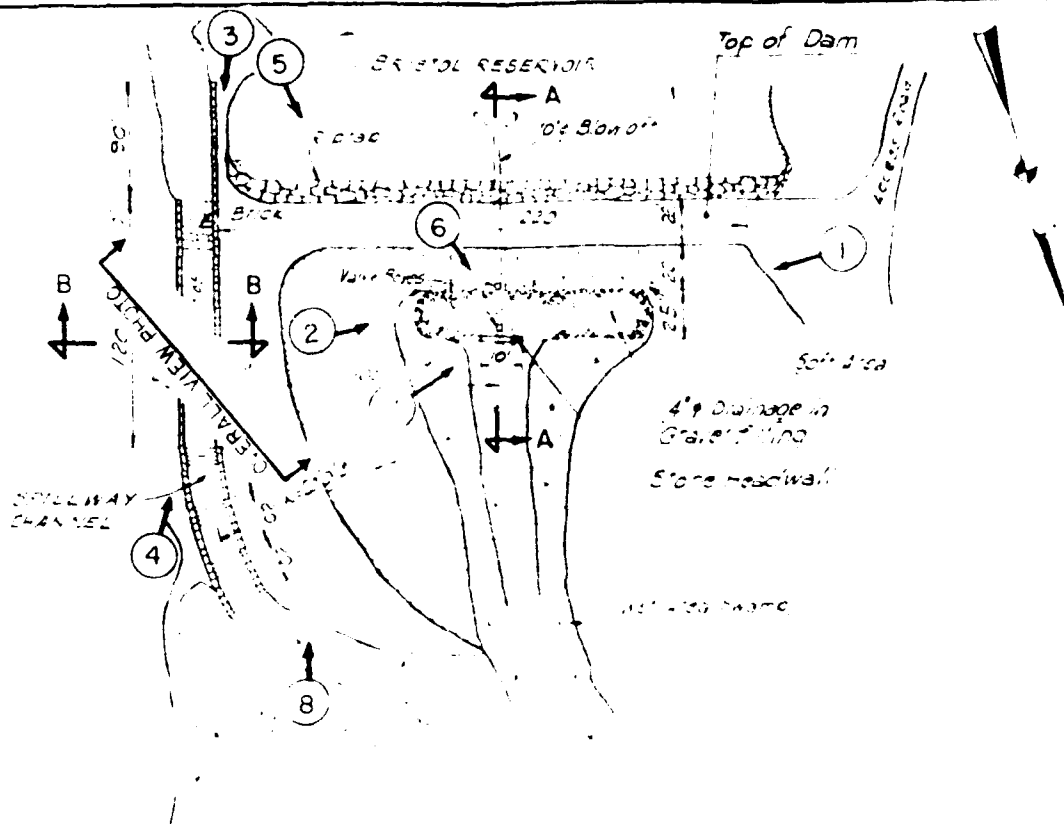
Not to Scale



SECTION B-B

Not to Scale

STORCH ENGINEERS OF ENGINEERS, ARCHITECTS AND PLANNERS, INC.		PLATE 2 U.S. ARMY ENGINEER DISTRICT OFFICE BOSTON, MASS.	
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
BRISTOL RESERVOIR DAM			
PEQUABUCK RIVER			
CONNECTICUT			
SCALE: NOT TO SCALE		DATE: MAY, 1970	



NOTE: INFORMATION TAKEN FROM
DRAWINGS SUPPLIED BY THE
BRISTOL WATER DEPARTMENT

GENERAL PLAN

(2) → DENOTES PHOTO LOCATION

STRUCTURAL ENGINEERS		U.S. ARMY ENGINEER DIVISION NEW ENGLAND CORPS OF ENGINEERS BALTIMORE, MARYLAND	
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS			
BRISTOL RESERVOIR DAM			
PEQUABUCK RIVER		CONNECTICUT	
DATE		NOT TO SCALE	
DATE		Nov 1978	

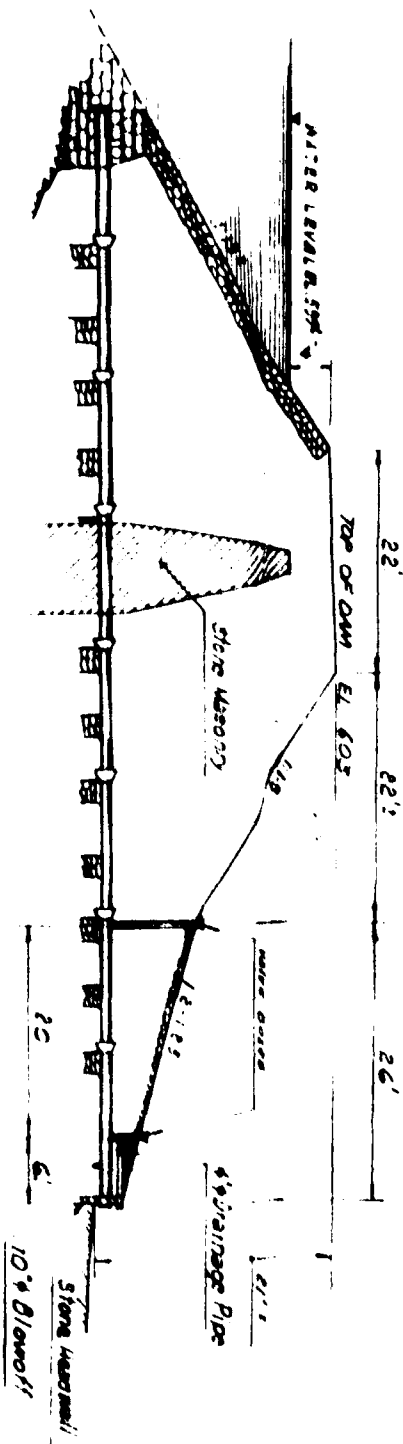
PLATE-3

GENERAL PLAN

STOCK ENGINEERS		PLATE-1
NATIONAL BUREAU OF SURVEYING OF THE UNITED STATES		
NATIONAL BUREAU OF SURVEYING OF THE UNITED STATES		
BRISTOL RESERVOIR DAM		
PENNA. RIVER		
SCALE: 1" = 100'		
DATE: MAY 1911		

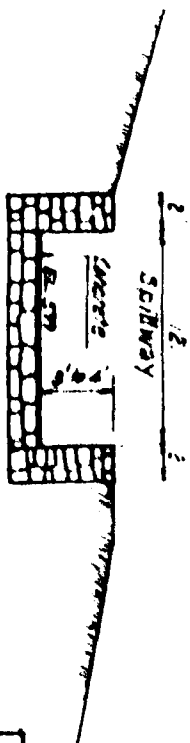
SECTION A-A

Not to Scale



SECTION B-B

Not to Scale



STOCK ENGINEERS		PLATE-2
NATIONAL BUREAU OF SURVEYING OF THE UNITED STATES		
NATIONAL BUREAU OF SURVEYING OF THE UNITED STATES		
BRISTOL RESERVOIR DAM		
PENNA. RIVER		
SCALE: 1" = 100'		
DATE: MAY 1911		



STORCH ENGINEERS NEW HAVEN, CONNECTICUT		PLATE - 4 U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS WATERWAYS DIVISION
NATIONAL PROGRAM OF INSPECTION OF NON-FED DAMS		
BRISTOL RESERVOIR DAM		
PEQUABUCK RIVER	CONNECTICUT	
SCALE AS SHOWN	DATE	Nov 1978

LEGEND

--- DENOTES LIMITS OF FLOODING
IN CASE OF DAM FAILURE